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REMARKS

Claims 1, 3-6, 8, 10-13, 15, 17-19, and 21-23 are all the claims pending in the application. Claims 1-6, 8-13, and 15-19, stand rejected on prior art grounds. Applicants respectfully traverse these rejections based on the following discussion.

I. Drawings/Specification

In regards to the drawings, the Office Action asserts that "the proposed replacement sheets have not been labeled 'Replacement Sheet' in the page header" (Office Action, p. 2, para. 2). Applicants hereby submit replacement sheets attached hereto, wherein the replacement sheets are labeled "Replacement Sheet" in the page header.

In regards to the specification, the Office Action asserts that "the proposed amended abstract has not been presented on a separate sheet" (Office Action, p. 2, para. 3). Applicants hereby submit an amended abstract attached hereto, wherein the amended abstract is presented on a separate sheet.

II. The Prior Art Rejections

Claims 1-6, and 15-19 stand rejected under 35 U.S.C. §102(b) as being anticipated by Dao, et al. (U.S. Patent No. 5,302,477), hereinafter referred to as Dao. Claims 1-6, and 15-19 stand rejected under 35 U.S.C. §102(e) as being anticipated by or, in the alternative, under 35 U.S.C. §103(a) as obvious over Schroeder, et al. (U.S. Publication No. 2003/0027057), hereinafter referred to as Schroeder. Claims 1-6, and 15-

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19 stand rejected under 35 U.S.C. §103(a) as being unpatentable over either Dao or Schroeder, in view of either Levenson (U.S. Patent No. 6,251,549) or Rolfson (U.S. Patent No. 6,395,432). Claims 8-13 stand rejected under 35 U.S.C. §103(a) as being unpatentable over either Dao or Schroeder, in view of Tzu, et al. (U.S. Patent No. 5,888,678), hereinafter referred to as Tzu. Claims 8-13 stand rejected under 35 U.S.C. §103(a) as being unpatentable over either Dao or Schroeder, in view of Tzu and in further view of either Levenson or Rolfson. Applicants respectfully traverse these rejections based on the following discussion.

The claimed invention provides a method of forming a phase shift mask comprising performing a first patterning of a substrate to expose a first region and performing additional patterning of the substrate to expose a second region. The additional patterning enlarges an opening formed in said first patterning. In the rejection, the Office Action argues that Dao, Schroeder, Levenson, Rolfson, and Tzu teach several of the features of the claimed invention. However, neither Dao, Schroeder, Levenson, Rolfson, nor Tzu, neither individually or in combination, teaches or suggests that an additional process for forming a second region enlarges an opening formed in a process for forming a first region. Instead, the removal of the patterning layer 61 (to form the second region) in Dao does not enlarge the opening formed during the chrome etch (to form the first region). Schroeder merely discloses that the substrate is patterned and etched to produce phase shift regions having a predetermined depth in the top surface of the substrate. Moreover, Levenson, Rolfson, and Tzu teach *simultaneously* forming first and second regions. Therefore, as explained in greater detail below, Applicants

respectfully submit that the prior art of record does not teach or suggest the claimed invention.

A. The rejection based on Dao

Applicants respectfully traverse this rejection because, contrary to the position in the Office Action, Dao fails to teach that said additional patterning enlarges an opening formed in said first patterning. Such features are defined in independent claims 1, 8, and 15 using similar language.

As illustrated in FIGS. 9-10 of Dao, a region 27 is formed by a process that removes portions of a chrome layer 21 that are not covered by a patterning layer 61. As discussed in column 9, lines 9-11 of Dao, a chrome etch is performed to remove the chrome in the region exposed by openings 62.

Following this, a region 24 is formed by a process that removes the patterning layer 61. As discussed in column 9, lines 11-17 of Dao, after removal of patterning layer 61, the reticle appears as shown in FIG. 10. Opening pattern 22, having phase-shifting rim 24 and opening 23, and opening pattern 25 having phase-shifting rim 27 and opening 26, with chrome element 21 between the two patterns, is shown.

However, the additional process that forms the region 24 (by removing the patterning layer 61) does not enlarge the opening formed by the first process that formed region 27 (the chrome etch).

Conversely, as discussed in paragraph 0020 of Applicants' disclosure, the invention performs additional patterning of the opaque layer 112 to expose a second

region 116 of the transparent substrate 110 that is adjacent (contiguous with) the first region 114 using any well-known mask 108 and material removal process, as shown in FIGS. 5A and 5B. This additional patterning process enlarges the opening 114, 116 formed in the first patterning process.

Further, as discussed in paragraph 0023, the processing here is beneficial for a number of different reasons. In one example, the invention eliminates various levels of processing, and reduces the complexity of that processing. The fact that less lithographic levels are required immediately reduces the number of design levels (design complexity, data volume, etc.). Reduction in lithographic processing levels also reduces the process complexity, and length (i.e., yield, TAT, capacity, defects, RPT). With the invention, the overlay requirements for each level also become less stringent, which improves yield, and TAT.

Accordingly, Applicants respectfully submit that Dao does not teach that an additional process for forming a second region enlarges an opening formed in a process for forming a first region. Instead, the removal of the patterning layer 61 (to form the second region) does not enlarge the opening formed during the chrome etch (to form the first region). Therefore, Dao does not teach or suggest the claimed feature "wherein said additional patterning enlarges an opening formed in said first patterning" as defined by independent claims 1 and 15, and "wherein said additional patterning enlarges openings formed in said first patterning" as defined by independent claim 8.

B. The rejection based on Schroeder

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Likewise, Schroeder fails to teach an additional process for forming a second region, wherein the additional process enlarges an opening formed during a process for forming a first region.

Schroeder provides a limited disclosure relating to the formation of phase shift regions. Specifically, as discussed in paragraph 0042, the substrate 402 is patterned and etched to produce regions 440 having a predetermined depth in the top surface of the substrate 400. Regions 440 create phase shift regions where light will be shifted by 180 degrees. As also discussed in paragraph 0046, the assist edges 450 and 452 are preferably formed by patterning regions 440 having a predetermined depth into the top surface of the substrate 402. Alternatively, assist edges 450 and 452 may be formed by depositing additional transparent layers on the substrate 402, or depositing materials that provide the required phase shift, for example, other transparent materials.

No further description of the formation of phase shift regions is provided in Schroeder. Schroeder does not disclose that a phase shift region is exposed via a patterning, wherein another phase shift region is subsequently exposed via an additional patterning. Rather, Schroeder merely discloses that the substrate is patterned and etched to produce phase shift regions having a predetermined depth in the top surface of the substrate.

Therefore, Schroeder does not teach the claimed feature of “performing a first patterning ... to expose a first region ... [and] performing additional patterning ... to expose a second region”, as defined by independent claims 1 and 15, and “performing a

first patterning ... to expose first regions ... [and] performing additional patterning ... to expose second regions”, as defined by independent claim 8.

Furthermore, because Schroeder fails to teach an additional patterning that is subsequent to a first patterning, then Schroeder clearly does not teach that such an additional patterning would enlarge an opening formed in a first patterning. Thus, Schroeder does not teach or suggest the claimed feature “wherein said additional patterning enlarges an opening formed in said first patterning” as defined by independent claims 1 and 15, and “wherein said additional patterning enlarges openings formed in said first patterning” as defined by independent claim 8.

In addition, the Office Action argues that “Applicant cannot distinguish the instant invention over this reference merely on the bases of apparent dimensions” (Office Action, p. 12, para. 2). Applicants respectfully disagree.

As clearly shown in Figures 6a and 6b, Schroeder fails to teach the claimed feature wherein “said second region comprises a similar shape and size as said first region” as defined in independent claims 1 and 15, and wherein “said second regions comprise similar shapes and sizes as said first regions” as defined by independent claim 8. More specifically, the first region 458 is nearly twice the size of the second region 460; and as such, Schroeder teaches away from the claimed invention.

Thus, the Office Action’s assertion that “the instant placement of PS features on a PSM appears to only be a matter of design choice” (Office Action, p. 13, para. 1) would render the claim language meaningless. Therefore, there is a fundamental difference between the claimed invention and Schroeder because Schroeder teaches different sized

first and second regions whereas the claimed invention is different because, as defined in independent claims 1, 8, and 15, "said second region[s] comprises a similar shape and size as said first region[s]".

C. The rejection based on Dao or Schroeder in view of Levenson or Rolfson

Applicants submit that Levenson is introduced by the Office Action for the sole purpose of illustrating first and second similarly shaped and sized regions that are adjacent one another. More specifically, the Office Action asserts that "neither Dao et al. or Schroeder et al. specifically teach a method of forming a PSM having adjacent first and second similarly shaped and sized rectangular 0° and 180° phase features ... However ... a PSM having book-matched adjacent first and second similarly shaped and sized rectangular regions is well known in the art of making PSMs, as exemplified by ... Levenson (Figures 9-11, col. 6 lines 53-61)" (Office Action, p. 9, para. 3-4).

However, Levenson fails to teach forming a second region after forming a first region, wherein the forming of the second region enlarges an opening formed when forming the first region (independent claims 1, 8, and 15). Such features are defined in independent claims 1, 8, and 15 using similar language.

To the contrary, Levenson teaches *simultaneously* forming the first and second regions. Specifically, as described in column 7, lines 63-64 of Levenson, the phase shift pattern 246 is formed in the material 242 by stamping, molding, or etching. As also described in column 7, line 65 – column 8, line 6, FIG. 25 shows a picture of construction of a generic substrate for a generic phase shift mask blank, whereby phase shift material

254 is deposited on the flat plate in the phase shift areas 256. Such deposition systems as plasma deposition, CVD deposition, and other deposition systems are known in the art. Dissolving the resist 252 lifts off the material 254 deposited on top of the resist, and leaves material 254 in the phase shift areas 256.

Nothing within Levenson discloses forming a second region after forming a first region. Moreover, nothing withing Levenson discloses that a subsequent process for forming a second region enlarges an opening formed during a prior process for forming a first region. In fact, the Office Action does not assert that such features are taught by Levenson.

Because the claimed feature wherein the additional patterning enlarges an opening formed in the first patterning (independent claims 1, 8, and 15) is also not taught by Dao and/or Schroeder, as discussed more fully above, Applicants submit that the proposed combination of Dao or Schroeder and Levenson would not have resulted in the claimed invention.

Applicants submit that Rolfson is introduced by the Office Action for the sole purpose of illustrating first and second similarly shaped and sized regions that are adjacent one another. More specifically, the Office Action asserts that "neither Dao et al. or Schroeder et al. specifically teach a method of forming a PSM having adjacent first and second similarly shaped and sized rectangular 0° and 180° phase features ... However ... a PSM having book-matched adjacent first and second similarly shaped and sized rectangular regions is well known in the art of making PSMs, as exemplified by ... Rolfson (Figure 12, col. 6 lines 28-36)" (Office Action, p. 9, para. 3-4).

However, Rolfson fails to teach forming a second region after forming a first region, wherein the forming of the second region enlarges an opening formed when forming the first region (independent claims 1, 8, and 15). Such features are defined in independent claims 1, 8, and 15 using similar language.

To the contrary, Rolfson teaches *simultaneously* forming the first and second regions. Specifically, Figures 1, 2, 5, and 6 of Rolfson illustrate successive processing steps of forming alternating phase shift regions 32 and 34 (See "Brief Description of the Drawings" section, col. 3, lines 4-14). Particularly, phase shift regions 32 and 34 are formed simultaneously in the processing step shown in FIG. 5. Nothing within Rolfson teaches or suggests exposing or otherwise forming a first region prior to a second region.

Moreover, because the second region is not formed after the first region, Rolfson does not teach an additional patterning for forming the second region, wherein the additional patterning enlarges an opening formed by a first patterning for forming the first region.

Accordingly, because the claimed feature wherein the additional patterning enlarges an opening formed in the first patterning (independent claims 1, 8, and 15) is also not taught by Dao and/or Schroeder, as discussed more fully above, Applicants submit that the proposed combination of Dao or Schroeder and Rolfson would not have resulted in the claimed invention.

D. The rejection based on Dao or Schroeder in view of Tzu

First of all, Applicants traverse this rejection because Tzu does not disclose patterning an opaque layer to expose the substrate. Such a feature is defined in independent claims 1 and 8 using the following language: “performing a first patterning of said opaque layer to expose a first region[s] of said transparent substrate ... and - performing additional patterning of said opaque layer to expose a second region[s] of said transparent substrate”, and in independent claim 15 wherein the opaque layer is chrome and wherein the substrate is quartz.

Specifically, as clearly illustrated in FIGS. 5-6 of Tzu, after removal of the opaque layer 30, the substrate 20 remains *unexposed*. As discussed in column 4, lines 16-19 of Tzu, the first pattern 37 and the second pattern 39 are etched in the layer of opaque material 30, in this example chrome, using wet isotropic etching with an etchant such as CR-7 (HClO₄, Cl(NH₄)₂(NO₃)₃). However, as illustrated in FIG. 6, after etching the opaque material 30, the phase shifting material 26 remains over the substrate 20; and as such, the substrate 20 remains *unexposed*.

Therefore, Applicants submit that Tzu fails to teach or suggest the claimed feature of performing a first patterning of said opaque layer to expose a first region of said transparent substrate and performing additional patterning of said opaque layer to expose a second region of said transparent substrate (independent claims 1, 8, and 15).

Secondly, when the substrate is finally exposed in Tzu, the first and second regions of the substrate are formed *simultaneously*. Thus, Tzu fails to teach or suggest the claimed feature of exposing a first region of the substrate via a first process, and

subsequently exposing a second region of the substrate via an additional process. Such features are defined in independent claims 1, 8, and 15 using similar language.

As discussed in column 4, lines 16-23 of Tzu, after the opaque layer is etched, the first pattern 37 and the second pattern 39 are etched in the layer of attenuating phase shifting material 26, in this example MoSiON, using dry anisotropic etching with an etchant such as CF.sub.4 and O.sub.2 (FIG. 7).

Thus, when the substrate 20 is finally exposed, the first pattern 37 and the second pattern 39 are formed *simultaneously* via an etching process of the phase shifting material 26. Therefore, Applicants submit that Tzu fails to teach the claimed feature of “performing a first patterning ... to expose a first region[s] of said transparent substrate... [and] performing additional patterning ... to expose a second region[s] of said transparent substrate” as defined by independent claims 1, 8, and 15.

Furthermore, because Tzu fails to teach an additional patterning to expose a second region of the substrate, then Tzu clearly fails to teach that such an additional patterning would enlarge an opening formed during a first patterning.

Accordingly, Applicants submit that Tzu fails to teach the claimed feature “wherein said additional patterning enlarges an opening formed in said first patterning” as defined by independent claims 1 and 15, and “wherein said additional patterning enlarges openings formed in said first patterning” as defined by independent claim 8.

Moreover, because the claimed feature wherein the additional patterning enlarges an opening formed in the first patterning is also not taught by Dao and/or Schroeder, as

discussed more fully above, Applicants submit that the proposed combination of Dao or Schroeder and Tzu would not have resulted in the claimed invention.

In addition, Applicants note that the second pattern 39 is not adjacent the first pattern 37 (i.e., portions of the opaque material 30 and the resist layer 32 separate the second pattern 39 from the first pattern 37). Therefore, there is a fundamental difference between the claimed invention and Tzu because Tzu teaches first and second regions that are separated by semiconductor components, whereas the claimed invention is different because the second region is adjacent the first region. As such, Tzu does not teach the claimed feature “wherein said second region is adjacent said first region”, as defined by independent claims 1 and 15, and “wherein said second regions are adjacent said first regions”, as defined by independent claim 8.

Moreover, as illustrated in FIGS. 10 and 11, the second pattern 39 does not have a similar shape and size as the first pattern 37. Specifically, as noted in the “Brief Description of the Drawings” section of Tzu (col. 3, lines 40-49), FIG. 10 shows a cross section view of the completed mask having a rim type attenuating phase shifting pattern (i.e., the second pattern 39) for *small* contact holes in one region of the mask and a binary mask pattern (i.e., the first pattern 37) for *large* contact holes in another region of the mask. Additionally, FIG. 11 shows a top view of a mask having a rim type attenuating phase shifting pattern (i.e., the second pattern 39) for *small* contact holes and a binary mask pattern (i.e., the first pattern 37) for *large* contact holes. Therefore, there is a fundamental difference between the claimed invention and Tzu because Tzu teaches

different shaped and sized first and second regions, whereas the claimed invention is different because the second region comprises a similar shape and size as the first region.

Therefore, contrary to the position taken in the Office Action, Tzu does not teach or suggest the claimed feature of wherein "said second region comprises a similar shape and size as said first region, wherein said second region is adjacent said first region" as defined by independent claims 1 and 15, and wherein "said second regions comprise similar shapes and sizes as said first regions, wherein said second regions are adjacent said first regions", as defined by independent claim 8.

Therefore, it is Applicants' position that the proposed combination of Dao, Schroeder, Levenson, Rolfson, and/or Tzu does not teach or suggest many features defined by independent claims 1, 8, and 15 and that such claims are patentable over the prior art of record. Further, it is Applicants' position that dependent claims 3-6, 10-13, 17-19, and 21-23 are similarly patentable, not only because of their dependency from a patentable independent claims, but also because of the additional features of the invention they defined. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the rejections.

II. Formal Matters and Conclusion

With respect to the objections to the specification, the specification has been amended, above, and the amended abstract is attached hereto on a separate sheet to overcome these objections. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the objections to the specification.

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With respect to the objections to the drawings, the drawings have been corrected, labeled replacement sheets and are attached hereto, to overcome these objections. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the objections to the drawings.

With respect to the rejections to the claims, the claims have been amended, above, to overcome these rejections. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the rejections to the claims.

In view of the foregoing, Applicants submit that claims 1, 3-6, 8, 10-13, 15, 17-19, and 21-23, all the claims presently pending in the application, are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.


Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary. Please charge any deficiencies and credit any overpayments to Attorney's Deposit Account Number 09-0456.

Respectfully submitted,

Dated: 10/5/06

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